

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application.

1. (currently amended) A method for programming non-volatile memory, comprising:
categorizing a set of non-volatile storage elements into three or more groups based on a detected behavior of said non-volatile storage elements; and
programming said non-volatile storage elements using a different programming condition for each group.
2. (currently amended) A The method according to claim 1, wherein:
said step of programming includes applying different bit line voltages for different groups.
3. (currently amended) A The method according to claim 1, wherein:
said step of programming includes applying a program signal to said non-volatile storage elements via a common word line and applying different bit line voltages for different groups.
4. (currently amended) A The method according to claim 1, wherein:
said step of categorizing includes determining programming speed information of said non-volatile storage elements relative to each other, each group including non-volatile storage elements with similar programming speed information.

5. (currently amended) A The method according to claim 1, wherein:

said step of categorizing includes determining programmability of said non-volatile storage elements relative to each other, each group including non-volatile storage elements with similar programmability.

6. (currently amended) A The method according to claim 1, wherein:

said step of categorizing includes applying one or more non-zero source voltages to said set of non-volatile storage elements and, while applying said one or more non-zero source voltages, characterizing threshold voltages of said set of non-volatile storage elements by applying one or more positive voltages to control gates for said non-volatile storage elements and determining whether said non-volatile storage elements turn-on in order to determine whether said non-volatile storage elements have a threshold voltage greater than a negative voltage compare point.

7. (currently amended) A The method according to claim 1, wherein:

said step of categorizing includes charging bit lines for said set of non-volatile storage elements, applying a control gate signal and allowing said bit lines to discharge; and

said step of programming said non-volatile storage elements using a different programming condition for each group includes adjusting a subset of bit line voltages based on how said bit lines discharged.

8. (currently amended) A The method according to claim 1, further comprising:

applying initial programming to said non-volatile storage elements prior to said step of programming said non-volatile storage elements using a different programming condition, said step of categorizing is based on said step of applying initial programming.

9. (currently amended) A The method according to claim 8, wherein:
said initial programming and said step of programming said non-volatile storage elements using a different programming condition are performed using a common program signal.

10. (currently amended) A The method according to claim 9, wherein:
said common program signal is applied via a common word line; and
said step of adjusting includes determining which of said non-volatile storage elements are slow to program, determining which of said non-volatile storage elements are fast to program and raising a voltage on bit lines for said non-volatile storage elements that are determined to be fast to program.

11. (currently amended) A The method according to claim 8, wherein:
said step of applying initial programming is performed until at least one non-volatile storage element reaches a target threshold value; and
said step of categorizing is performed for non-volatile storage elements that did not yet reach said target threshold value.

12. (currently amended) A The method according to claim 1, wherein:
said non-volatile storage elements are multi-state storage elements.

13. (currently amended) A The method according to claim 1, wherein:
said non-volatile storage elements are multi-state NAND flash memory elements.

14. (currently amended) A system for programming non-volatile memory,
comprising:
a set of non-volatile storage elements;
a set of control lines in communication with said set of non-volatile storage elements; and

a controlling circuit in communication with said control lines, said controlling circuit causes a categorizing of said set of non-volatile storage elements into three or more groups based on a detected behavior of said non-volatile storage elements and causes programming of said non-volatile storage elements using a different programming condition for each group.

15. (currently amended) A The system according to claim 14, wherein:
said control lines includes a set of bit lines and a common word line;
said controlling circuit causes application of a program signal on said common word line;
and
said different program condition for each group pertains to different bit line voltages.

16. (currently amended) A The system according to claim 14, wherein:
said categorizing includes determining programming speed information of said non-volatile storage elements relative to each other, each group including non-volatile storage elements with similar speed information.

17. (currently amended) A The system according to claim 14, wherein:
said categorizing includes determining ~~programming speed information~~ programmability of said non-volatile storage elements relative to each other, each group including non-volatile storage elements with similar speed information.

18. (currently amended) A The system according to claim 14, wherein:
said ~~step of~~ categorizing includes applying a non-zero source voltage to said set of non-volatile storage elements and, while applying said non-zero source voltage, characterizing threshold voltages of said set of non-volatile storage elements by applying one or more positive voltages to control gates for said non-volatile storage elements and determining whether said non-volatile storage elements turn-on in order to determine whether said non-volatile storage elements have a threshold voltage greater than a compare point.

19. (currently amended) ~~A~~ The system according to claim 14, wherein:
said categorizing includes charging bit lines for said set of non-volatile storage elements,
applying a common control gate signal and allowing said bit lines to discharge; and
said programming of said non-volatile storage elements using a different programming
condition for each group includes adjusting a subset of bit line voltages based on how said bit
lines discharged.

20. (currently amended) ~~A~~ The system according to claim 14, wherein:
said controller circuit causes initial programming to said non-volatile storage elements
prior to said programming said non-volatile storage elements using a different programming
condition, said categorizing is based on said initial programming.

21. (currently amended) ~~A~~ The method-system according to claim 20, wherein:
said initial programming is performed until at least one non-volatile storage element
reaches a target threshold value; and
said categorizing is performed for non-volatile storage elements that did not yet reach
said target threshold value.

22. (currently amended) ~~A~~ The system according to claim 20, wherein:
said initial programming is performed using a common word line signal.

23. (currently amended) ~~A~~ The system according to claim 14, wherein:
said non-volatile storage elements are multi-state storage elements.

24. (currently amended) ~~A~~ The system according to claim 14, wherein:
said non-volatile storage elements are multi-state NAND flash memory elements.

25. (original) A method for programming non-volatile memory, comprising:
applying initial programming to non-volatile storage elements until at least one non-volatile storage element reaches a target threshold value; and
adjusting programming of at least a subset of non-volatile storage elements that have not reached said target threshold value based on behavior of said non-volatile storage elements that have not reached said target threshold value.

26. (currently amended) ~~A~~ The method according to claim 25, further comprising:
characterizing said non-volatile storage elements that have not reached said target threshold value based on programmability, said step of adjusting is based on said step of characterizing.

27. (currently amended) ~~A~~ The method according to claim 26, wherein:
said step of characterizing includes comparing a predetermined threshold voltage to threshold voltages for said non-volatile storage elements that have not reached said target threshold value.

28. (currently amended) ~~A~~ The method according to claim 27, wherein:
said step of adjusting includes raising bit line voltages for non-volatile storage elements that have threshold voltages greater than said predetermined threshold voltage.

29. (currently amended) ~~A~~ The method according to claim 25, further comprising:
said step of applying initial programming to non-volatile storage elements includes applying a common program voltage signal to said non-volatile storage elements, said common program voltage signal increases at a first rate; and
said step of adjusting includes increasing said common program voltage signal above said first rate.

30. (currently amended) ~~A~~ The method according to claim 25, further comprising:
said step of applying initial programming to non-volatile storage elements and said step of adjusting include applying a common program voltage signal to said non-volatile storage elements.

31. (currently amended) ~~A~~ The method according to claim 25, further comprising:
said step of applying initial programming to non-volatile storage elements and said step of adjusting include applying a common program voltage signal to control gates of said non-volatile storage elements.

32. (currently amended) ~~A~~ The method according to claim 25, wherein:
said step of adjusting includes applying a non-zero source voltage to at least a subset of said non-volatile storage elements and comparing threshold voltages of said subset of non-volatile storage elements to a predetermined positive control gate value while applying said non-zero source voltage in order to determine programmability of said subset of non-volatile storage elements.

33. (currently amended) ~~A~~ The method according to claim 25, wherein:
said step of adjusting includes charging bit lines for at least a subset of said non-volatile storage elements, applying a control gate signal to said subset of said non-volatile storage elements and allowing said bit lines to discharge; and
said step of adjusting further includes adjusting a subset of said bit line voltages for programming based on how said bit lines discharged.

34. (currently amended) ~~A~~ The method according to claim 25, wherein:
said non-volatile storage elements are multi-state storage elements.

35. (currently amended) ~~A~~ The method according to claim 25, wherein:
said non-volatile storage elements are multi-state NAND flash memory elements.

36. (original) A system for programming non-volatile memory, comprising:
a set of non-volatile storage elements;
control lines in communication with said set of non-volatile storage elements; and
a controlling circuit in communication with said control lines, said controlling circuit
causes initial programming of said non-volatile storage elements until at least one non-volatile
storage element reaches a target threshold value, said controlling circuit causes adjustment of
programming of at least a subset of non-volatile storage elements that have not reached said
target threshold value based on behavior of said non-volatile storage elements that have not
reached said target threshold value.

37. (currently amended) ~~A~~ The system according to claim 36, wherein:
said controlling circuit causes characterization of non-volatile storage elements that have
not reached said target threshold value based on programmability, said adjustment of
programming is based on said characterization.

38. (currently amended) ~~A~~ The system according to claim 37, wherein:
said characterization includes comparing a predetermined threshold voltage to threshold
voltages for said non-volatile storage elements that have not reached said target threshold, said
predetermined threshold voltage is lower than said target threshold value.

39. (currently amended) ~~A~~ The system according to claim 38, wherein:
said adjustment of programming includes raising bit line voltages for non-volatile storage
elements that have threshold voltages greater than said predetermined threshold voltage.

40. (currently amended) ~~A~~ The system according to claim 36, wherein:
said initial programming includes applying a common program voltage signal to said non-volatile storage elements, said common program voltage signal increases at a first rate; and
said adjustment of programming includes increasing said common program voltage signal above said first rate.

41. (currently amended) ~~A~~ The system according to claim 36, wherein:
said initial programming includes applying a common program voltage signal to said non-volatile storage elements.

42. (currently amended) ~~A~~ The system according to claim 36, wherein:
said adjustment of programming includes applying a non-zero source voltage to at least a subset of said non-volatile storage elements and comparing threshold voltages of said subset of non-volatile storage elements to a predetermined positive control gate value while applying said non-zero source voltage in order to determine programmability of said subset of non-volatile storage elements.

43. (currently amended) ~~A~~ The system according to claim 36, wherein:
said adjustment of programming includes charging bit lines for at least a subset of said non-volatile storage elements, applying a control gate signal to said subset of said non-volatile storage elements and allowing said bit lines to discharge; and
said adjustment of programming further includes adjusting a subset of said bit line voltages for ~~programming~~ programming based on how said bit lines discharged.

44. (currently amended) ~~A~~ The system according to claim 36, wherein:
said non-volatile storage elements are multi-state storage elements.

45. (currently amended) ~~A~~ The system according to claim 36, wherein:
said non-volatile storage elements are multi-state NAND flash memory elements.

46. (original) A method for programming non-volatile memory, comprising:
applying an initial program signal to a set of non-volatile storage elements;
applying one or more non-zero source voltages to said set of non-volatile storage elements after commencing said initial program signal;
while applying said one or more non-zero source voltages, characterizing threshold voltages of said set of non-volatile storage elements by applying one or more positive voltages to control gates for said non-volatile storage elements and determining whether said non-volatile storage elements turn-on in order to determine whether said non-volatile storage elements have a threshold voltage greater than a compare point; and
adjusting a programming parameter of at least a subset of said non-volatile storage elements based on said step of characterizing.

47. (currently amended) ~~A~~ The method according claim 46, wherein:
said compare point is a negative voltage.

48. (currently amended) ~~A~~ The method according to claim 46, wherein:
said initial program signal is applied via a common word line; and
said adjusting said programming parameter includes raising a voltage on one or more bit lines for said non-volatile storage elements.

49. (original) A system for programming non-volatile memory, comprising:
a set of non-volatile storage elements;
control lines in communication with said set of non-volatile storage elements; and
a controlling circuit in communication with said control lines, said controlling circuit causes:

application of an initial program signal to said set of non-volatile storage elements,

while applying one or more non-zero source voltages, characterization of threshold voltages of said set of non-volatile storage elements by applying a voltage to control gates for said non-volatile storage elements and determining whether said non-volatile storage elements turn-on in order to determine whether said non-volatile storage elements have a threshold voltage greater than a compare point; and

adjustment of control line voltages of at least a subset of said non-volatile storage elements based on said step of characterizing.

50. (currently amended) ~~A~~ The system according to claim 49, wherein:
said control lines includes a set of bit lines and a common word line;
said initial program signal is applied via said common word line; and
said adjustment of said control line voltages includes raising one or more bit line voltages.

51. (original) A method for programming non-volatile memory, comprising:
applying an initial program signal to a non-volatile storage element;
applying a verify signal to a control gate for said of non-volatile storage element after commencing said applying of said initial program signal;
charging a bit line for said of non-volatile storage element after commencing said applying of said initial program signal;
allowing said bit line to discharge; and
adjusting a programming parameter of said non-volatile storage elements based on said bit line discharging.

52. (currently amended) ~~A~~ The method according to claim 51, wherein:
said initial program signal is applied via a common word line; and

said adjusting of said programming parameter includes raising a bit line voltage for said non-volatile storage element for subsequent programming.

53. (currently amended) ~~A~~ The method according to claim 51, wherein:
said non-volatile storage element is a flash memory device.

54. (original) A system for programming non-volatile memory, comprising:
a set of non-volatile storage elements;
a word line in communication with said set of non-volatile storage elements;
a set of bit lines in communication with said set of non-volatile storage elements; and
a controlling circuit in communication with said word line, said control lines, and said non-volatile storage elements, said controlling circuit causes:
application of an initial program signal to said non-volatile storage elements,
application of a verify signal at a word line for said of non-volatile storage elements after commencing said initial program signal,
charging of bit lines for said of non-volatile storage elements after commencing said initial program signal,
allowing of said bit lines to discharge,
adjustment of a programming parameter of at least a subset of said non-volatile storage elements based on said bit line discharging, and
completion of programming of said non-volatile storage elements using said adjusted programming parameter.

55. (currently amended) ~~A~~ The system according to claim 54, wherein:
said initial program signal is applied via said word line, said word line is common to all said non-volatile storage elements; and
said adjustment of said programming parameter includes raising one or more of said bit lines.

56. (currently amended) ~~A~~ The system according to claim 54, wherein:
said program parameter is adjusted differently for different non-volatile storage elements.

57. (currently amended) ~~A~~ The system according to claim 54, wherein:
said non-volatile storage elements are flash memory devices.